DOCUMENT RESUME

ED 436 355 SE 061 722

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TITLE Problems Students Encounter during Math Instruction in Mixed-Ability Classrooms.
PUB DATE 1998-05-00
NOTE 50p.; Master's Action Research Project, Saint Xavier University and IRI/Skylight.
PUB TYPE Dissertations/Theses (040)
EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Cooperative Learning; Elementary Education; Grouping (Instructional Purposes); *Mathematics Instruction; *Motivation; Teaching Methods

ABSTRACT

This report describes a program for increasing enthusiasm for math. The targeted population consisted of mixed-ability split second and third grade self-contained cross categorical, regular education third, and regular education fifth grade math classes in a suburban area located in the Midwest. The problem of frustration, inattentiveness and lack of motivation were documented by inattentive behavior checklists, student surveys, and reflective journals. Analysis of probable cause data at the site and in the literature indicated that students were frustrated, bored, and inattentive because their needs were not being met through the current educational system in which students of all ability levels were being taught in the same classroom. A review of solution strategies suggested by knowledgeable others resulted in the development of a program that consisted of whole group instruction, compacting, and small group work. The goal of this program was to enhance motivation and enthusiasm during math. Whole group instruction introduced or reacquainted students with math concepts and vocabulary. Compacting helped meet the needs of every student. Small group work provided students the opportunity to work in heterogeneous groups. Implementation of the solution strategies increased motivation for math while decreasing inattentive behaviors. The use of curriculum compacting helped differentiate instruction. Through whole group instruction and cooperative learning, students were given a feeling of belonging. These solution strategies contributed to improving students' enthusiasm for math. (Contains 32 references.) (Author)

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PROBLEMS STUDENTS ENCOUNTER DURING MATH INSTRUCTION IN MIXED-ABILITY CLASSROOMS

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An Action Research Project Submitted to the Graduate Faculty of the

School of Education in Partial Fulfillment of the

Requirements for the Degree of Master of Arts in Teaching and Leadership

Saint Xavier University & IRI/Skylight

Field-Based Masters Program

Chicago, Illinois

May, 1998

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ABSTRACT

This report describes a program for increasing enthusiasm for math. The targeted population consisted of mixed-ability split second and third grade self-contained cross categorical, regular education third, and regular education fifth grade math classes in a suburban area located in the Midwest. The problem of frustration, inattentiveness and lack of motivation were documented by inattentive behavior checklists, student surveys, and reflective journals.

Analysis of probable cause data at the site and in the literature indicated that students were frustrated, bored, and inattentive because their needs were not being met through the current educational system in which students of all ability levels were being taught in the same classroom.

A review of solution strategies suggested by knowledgeable others resulted in the development of a program that consisted of whole group instruction, compacting, and small group work. The goal of this program was to enhance motivation and enthusiasm during math. Whole group instruction introduced or reacquainted students with math concepts and vocabulary. Compacting helped meet the needs of every student. Small group work provided students the opportunity to work in heterogeneous groups.

Implementation of the solution strategies increased motivation for math while decreasing inattentive behaviors. The use of curriculum compacting helped differentiate instruction. Through whole group instruction and cooperative learning, students were given a feeling of belonging. These solution strategies contributed to improving students' enthusiasm for math.

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CHAPTER 1

PROBLEM STATEMENT AND CONTEXT

General Statement of the Problem

The students of the targeted mixed-ability second/third grade self-contained cross categorical, regular education third, and regular education fifth grade math classes exhibit frustration, inattentiveness, and lack of motivation that interferes with their enthusiasm for math. Evidence for the existence of the problem includes an inattentive behavior checklist, student surveys, and reflective journals.

Teacher observation of the student's behavior indicate that while teachers teach to the middle academic ability level, they are not challenging the higher ability student or addressing the lower ability student's needs. Therefore, both groups demonstrate frustration, inattentiveness and lack of motivation possibly causing a lack of interest in math.

Immediate Problem Context

Site A has a total enrollment of 873 students and is a pre-kindergarten through second grade building. Site B has a total enrollment of 1,469 students and is made up of third, fourth and fifth grades.

The racial and ethnic background of both sites is presented in Figure 1. Over 80% of the population in both schools is white. The remaining population is made up of Black, Hispanic, Asian/Pacific Islander and Native American. Site A has 1.7% of its students coming from low

income families and 5% are Limited-English-Proficient. Site B has 3.1% low income students and 2.9% of the enrollment are Limited-English Proficient.

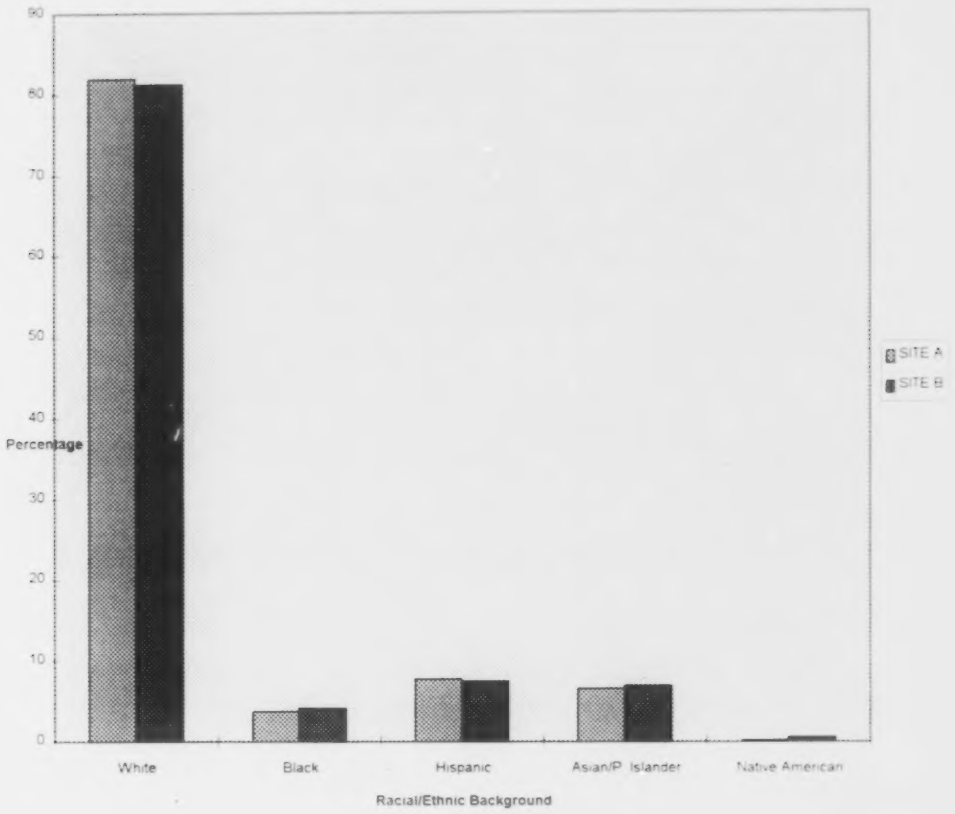

Figure 1. Percentage of students' racial ethnic background for Site A and Site B.

The attendance, mobility, and chronic truancy is presented in Figure 2. Attendance at both schools is approximately 95%. Student mobility is 13.3% at Site A. Student mobility at Site B is 12.7%. Chronic truancy is not a problem at Site A; however at Site B, the chronic truancy rate jumps to 8.6%.

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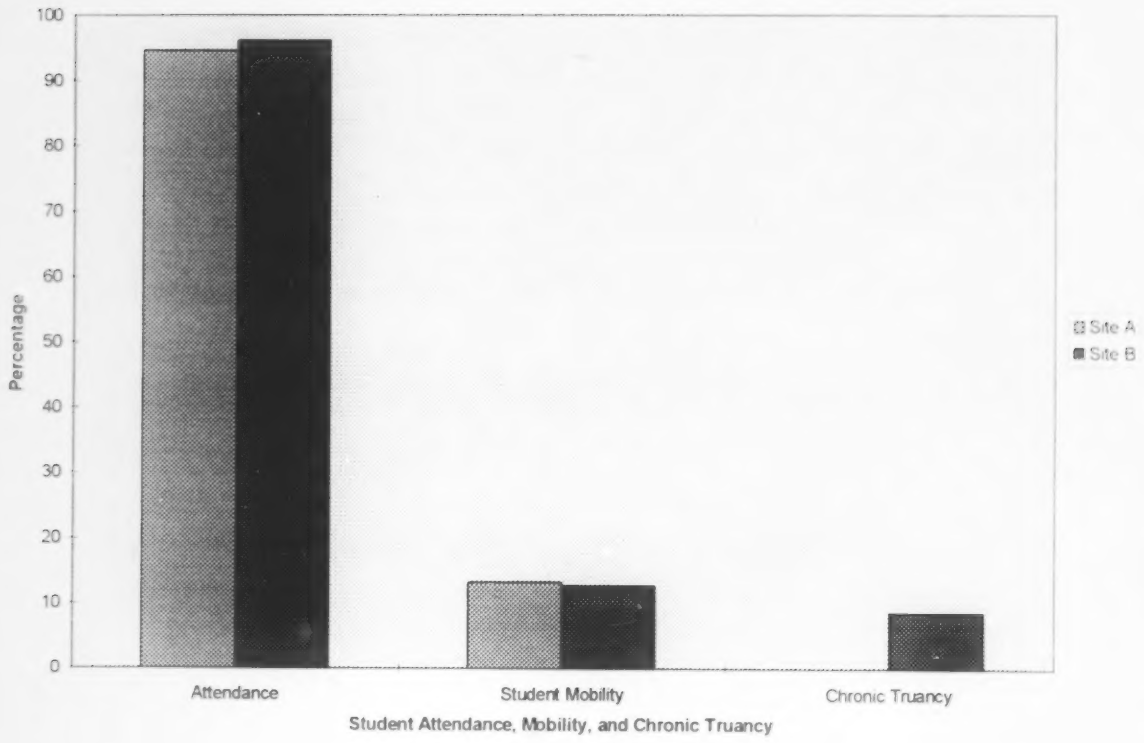

Figure 2. Percentage of students' attendance, mobility, and chronic truancy.

Site A is attached to another primary site. The whole site was built in 1952. It has had four additions since the original construction. Site A takes up half of the building; however, there is a principal that runs each site. Site B is across the street from Site A. The building was built in 1967. Two additions have been added to the original building.

Site A has 6 morning and 6 afternoon kindergarten classes, 12 first grades, 10 second grades, 1 kindergarten/first grade self-contained cross categorical class, and 1 second grade self-contained cross categorical class. The support service staff includes one learning disabilities resource (LDR), one behavior disorders resource (BDR), three social workers, two speech

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therapists, one English as a second language (ESL), four reading recovery, one reading specialist, one occupational therapist, and one psychologist.

Site B has 20 third grades, 17 fourth grades, and 17 fifth grades, 1 third grade self-contained cross categorical class, 1 third/fourth self-contained cross categorical class, 1 fourth self-contained cross categorical class, 1 fourth/fifth self-contained cross categorical class, 1 fifth self-contained cross categorical class, and 1 self-contained behavior disorder class. The support staff includes four learning disabilities resource (LDR), one behavior disorders resource (BDR), three social workers, two speech therapists, one English as a second language (ESL), two reading specialists, and two psychologists.

Table 1 shows the average years of experience, educational levels attained, pupil-teacher ratio and pupil-administration ratio for the district. The average teaching experience is 10.0 years. The majority of the staff has a Bachelor's Degree. Only 33.1% of the teachers have a Master's Degree or above. The figures for the district are below the state average. The pupil-teacher ratio is 21.1 to 1. The pupil-teacher ratio and the pupil-administration are also above the average for the state.

Table 1

Categories, Type, and Percentage of Teacher/Administrator Characteristics as of the 1996 School Report Card.

	Average Teaching Experience	Teachers with Bachelor's Degree	Teachers with Master's & Above	Pupil-Teacher Ratio Elementary	Pupil-Administration Ratio
District	10.0 Yrs.	66.9%	346.0:1	21.1:1	
Type*	13.6 Yrs.	57.6%	42.4%	19.0:1	233.9:1
Size**	13.6 Yrs.	53.4%	46.6%	19.7:1	249.7:1
State	14.4 Yrs.	55.6%	44.2%	19.5:1	253.2:1

* Average for all Elementary Districts

** Average for all Large Elementary Districts

Site A and Site B incorporate many programs into its curriculum. Super Math is a program for advanced students in math. These students must meet stringent criteria to be accepted to the program. There is currently only one class per grade level, approximately 30 students, that are accepted in Super Math. Creative Art is a gifted art program for those children who meet specified criteria. Creative Exploration is a Language Arts based gifted program. Students are also accepted based on specified criteria. Site B also has a Peer Mediation program that incorporates conflict/resolution and utilizes students as peer mediators.

The Surrounding Community

The district covers 33 square miles in a suburban location and serves many surrounding communities. The district is made up of one school which is housed in three separate buildings. There are two primary buildings, one intermediate building, and one middle school building. The primary buildings house pre-kindergarten through second grade, the intermediate building houses grades third through fifth, and the middle school building contains grades sixth through eighth.

The administrative structure is made up of one Superintendent, one Curriculum and Instruction Director, one Pupil Personnel Services Director, one Operations Manager, one Public Relations Manager, one Human Resource Director, one Buildings & Grounds Manager, one Finance Director, and one Technology Coordinator. There is one Principal for each school. The primary buildings share one Assistant Principal. The other two buildings each have two Assistant Principals.

The District has an enrollment of 4,498 students in pre-kindergarten through eighth grade. Figure 3 shows the racial/ethnic background of the district. The school district is predominately White. The remaining population is made up of Black, Hispanic, Asian/Pacific Islander, and Native American.

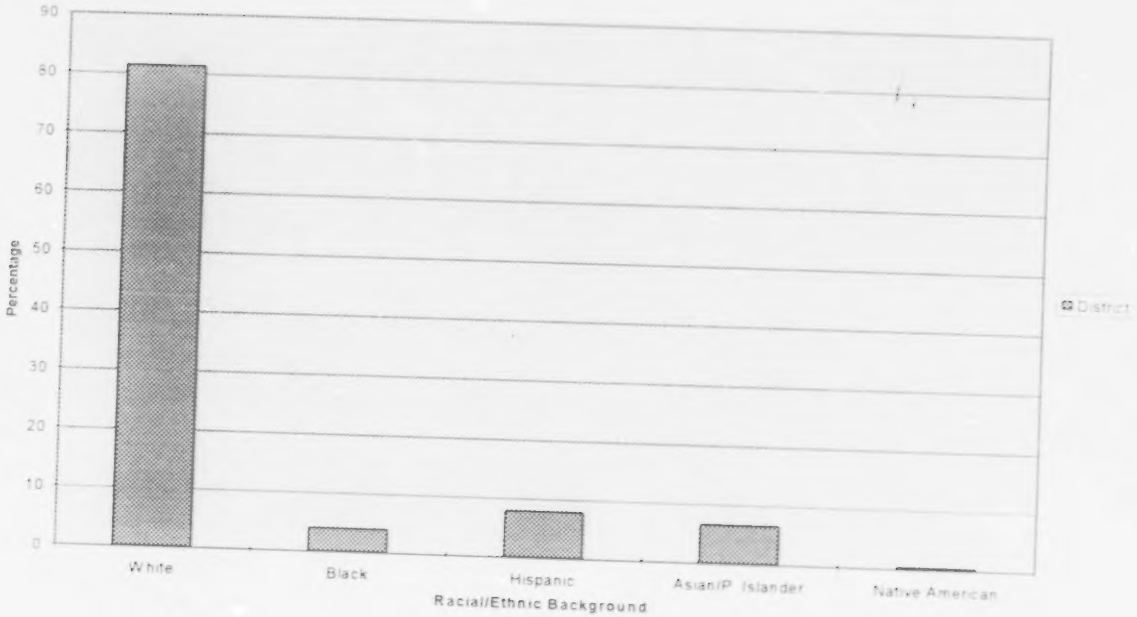

Figure 3. Percentage of students' racial/ethnic background for the District.

According to a demographic analysis prepared in August of 1995, the population of the communities in the district was approximately 35,000. The report showed a 54% population growth from the beginning of the decade. The race and ethnic origin of the District's population is predominately White. The largest minority is comprised of Hispanics. The median household income is $45,000.00. According to the 1996 School Report Card, 2.4% of the students are from low-income families. The data in the demographic analysis suggests that many households in the District are younger families with at least one child living at home.

The District is very large and growing. Currently, there are approximately 20 classes per grade level. The school was restructured for the 1997/1998 school year. This restructuring increased each grade level to approximately 30 classes per grade level. The buildings were also

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restructured. The original primary building now contains only pre-kindergarten through first grade (with six second grade classes). The old Intermediate School building houses second and third grades and was renamed the Elementary School. The old Middle School building houses fourth and fifth grade classes and was the Intermediate School. The sixth through eighth grade classrooms moved down the street to a brand new Middle School. There is also concern that another new building will have to be built in the near future.

National Context of the Problem

The problem of frustration, inattentiveness, and lack of motivation exhibited by children in mixed-ability classrooms has generated concern at the national levels. Many schools have mixed-ability classrooms. Students in these classrooms have many different learning styles and ability levels. They also have different emotional and social maturity levels.

Teachers in mixed-ability classrooms face many challenges. "Each September, many first graders arrive already able to read third grade books with comprehension, while their peers grapple for months with the idea of left-to-right print progression or the difference between short and long vowels" (Tomlinson, 1995c, p. 1). . Surprisingly, the most able students tend to learn less new material than the least able students (Winebrenner, 1992).

According to Tomlinson (1995a), at any given time, students reflect differing levels of academic readiness in various subjects and in various aspects of a single subject. "Acknowledging that students learn at different speeds and that they differ widely in their ability to think abstractly or understand complex ideas is like acknowledging that students at any given age aren't all the same height. It is not a statement of worth, but of reality" (Tomlinson, 1995c, p. 2).

According to Winebrenner (1992), when teachers assume that the curriculum guides they have been given must be applied to all students, it creates a situation that most gifted students

have a hard time dealing with. Many of these students will go through the motions, do the work and get an easy "A". Other gifted students who are less motivated will turn in work that is sloppy and careless, because they feel they are wasting their time on information they already know (Winebrenner, 1992). "Still other gifted students will simply give up, reject any more repetition, and refuse to do something they know is not necessary" (Winebrenner, 1992, p. 12).

On the other hand, children who are below average get frustrated when teachers direct the instruction to average learners. "Children only regress at frustration level. Some people will never be able to run a 4-minute mile or to play Beethoven's Moonlight Sonata" (Worthy & Hoffman, 1996, p. 657).

Students come to classrooms with different background knowledge. This background knowledge dictates the next thing in their learning process. "Therefore, that 'next thing' is where learning effort should be focused. Because students learn at different rates, 'the same for everyone' is too difficult for some and too easy for others" (Hunter, 1977, p. 9).

According to Hunter and Breit (1976), to increase motivation there must be a certain amount of anxiety present. In order for a child to learn, there must be some anxiety. If there is too much anxiety, a student will use his/her energy to combat the anxiety. If there is no anxiety, a student will be unmotivated. This demonstrates the types of problems that will occur when presenting material to one ability level. Therefore, in a mixed-ability classroom, these types of problems will be apparent. Lower, middle, and higher level ability students may demonstrate inattentiveness, frustration, and a lack of motivation when teachers teach to a specific academic ability or teach the same material to everyone.

CHAPTER 2

PROBLEM DOCUMENTATION

Problem Evidence

In order to document a student's enthusiasm for math, a reflective journal, an attitude survey, a scope and sequence survey, and an inattentive behavior checklist were given during whole group instruction within the first weeks of the school year. The second/third grade self-contained cross categorical class will be referred to as Class A and consists of nine students Students in this class are second, third, and fourth grade age; however, the majority of the students are third grade age. Class B is a regular education third grade class and consists of 22 students. There are also 22 students in Class C which is a regular education fifth grade class. The information gathered will be used to support that the problem exists.

Reflective Journal

During the first weeks of the school year, math instruction was conducted as a whole group lesson. After two separate lessons, all students were asked to complete a reflective journal (Appendix A) to indicate how they felt about that days' lesson. Class A responded positively to the format of the lesson with 76% of the students feeling happy about the lesson. The remaining 24% felt okay or sad about the lesson. Class B and C responded more negatively to the whole group lesson. Approximately 40% of each class felt happy and the other 60% felt okay or sad about the lesson. Class B and C provide evidence that students do not enjoy whole group math

lessons. Most of these students responded negatively to the traditional methods of teaching math However, Class A responded more favorably to whole group instruction which may be due to more individualized instruction. First of all, Class A consists of only nine students, one teacher, and one assistant. Also, most of these students had the same teacher last year which may make them feel more comfortable. The information gathered from the reflective journal indicates that most students did not like the structure of the whole group lesson. Similar results were apparent in the attitude survey.

Attitude Survey

A survey (Appendix B) was administered to document students' attitudes toward math An analysis of the results are shown in Table 2. All classes showed similar results in regards to how students generally felt about math in school. Approximately 55% of all Class B and C felt okay or sad about math in school, whereas Class A had approximately 44% feeling this way. Perhaps this difference is due to the student teacher ratio in Class A. Class A is a self-contained cross categorical class with one teacher, one assistant, and only nine math students. These students may feel more positive about math because of the individualized attention they receive and the fact that five of these students were together with this same teacher last year.

The survey then asked more specific questions to give the researchers an indication of what students like and dislike about math. The majority of the students prefer working with a friend or working in small groups rather than completing a drill worksheet independently. Another strong indication that students lack enthusiasm for math is shown by their responses to questions in the survey regarding free time spent on math, questions about math, and reading and writing about math. Table 2 shows that the majority of students responded that they felt okay or

sad about engaging in these types of math activities. The results of the survey further document that these students lack enthusiasm for math. The information from the students' questionnaires helped develop the strategies to be used in the action plan. In addition to the attitude survey, students also were surveyed about the scope and sequence of the curriculum.

Table 2

Students' Attitudes Toward Math

	Class A			Class B			Class C		
	☺	😐	☹	☺	😐	☹	☺	😐	☹
Math in School	55.5%	11.1%	33.3%	40.9%	40.9%	18.1%	45.4%	50.0%	4.5%
Math at Home	22.2%	22.2%	55.5%	45.4%	36.3%	18.1%	45.4%	45.4%	9.1%
Math with a Friend	66.6%	22.2%	11.1%	81.8%	4.5%	13.6%	63.6%	31.8%	4.5%
Free Time on Math	33.3%	11.1%	55.5%	13.6%	31.8%	54.5%	36.3%	36.3%	27.2%
New Skill or Concept	22.2%	0%	77.7%	63.6%	36.3%	0%	50.0%	40.9%	9.1%
Using Manipulatives	33.3%	11.1%	55.5%	59.1%	36.3%	4.5%	45.4%	40.9%	13.6%
Questions about Math	22.2%	44.4%	33.3%	13.6%	54.5%	31.8%	36.3%	45.4%	18.1%
Worksheets	22.2%	11.1%	66.6%	40.9%	45.4%	13.6%	45.4%	45.4%	9.1%
Small Group Work	55.5%	22.2%	22.2%	63.6%	22.7%	13.6%	72.7%	27.2%	0%
Reading about Math	22.2%	11.1%	66.6%	27.2%	50.0%	22.7%	18.1%	50.0%	31.8%
Writing about Math	44.4%	11.1%	44.4%	22.7%	31.8%	45.4%	22.7%	68.2%	9.1%
Math Tests	22.2%	22.2%	55.5%	27.2%	59.1%	13.6%	31.8%	50.0%	18.1%

Scope and Sequence Survey

Students were surveyed (Appendix C) to find out whether they have been taught concepts they already know or moved on to new concepts before they were ready. Table 3 shows the percentage breakdown of the responses students gave. Approximately half of Class A responded that they have been taught concepts that they already knew. However, students in Class A stated that they have not moved on to new concepts before they were ready. These results are consistent with the data gathered from the reflective journal and the attitude survey. The results may be attributed to the individualized structure of the class. However, the majority of Class B

and C replied that they had been taught concepts they already knew. Approximately 60% of both Class B and C answered that they have moved on to new concepts before they were ready. Therefore, some students may be frustrated with the pace of instruction thereby causing inattentive behaviors. Inattentive behaviors were examined using a behavior checklist. This information was gathered to confirm that inattentive behaviors could be caused by repetition in the curriculum or by moving too fast through materials.

Table 3

Students' Survey Regarding Scope and Sequence of Math Instruction

	Class A Yes	Class A No	Class B Yes	Class B No	Class C Yes	Class C No
Taught Concepts Already Known	56%	44%	91%	9%	95%	5%
New Concepts Taught before Ready	0%	100%	64%	36%	59%	41%

Behavior Checklist

During two whole group lessons an inattentive behavior checklist (Appendix D) was used to document the number of times students were off task. Class A documented behavior for two 15 minute periods and recorded 138 off-task behaviors. Class B and C documented behavior for two one hour periods. Class B documented 57 off-task behaviors and C recorded 89 off-task behaviors. The inattentive behaviors documented were talking, leaving their seat, fidgeting, inappropriate responses, and other. Inappropriate responses consisted of students answering questions without being aware of what question was asked. The other's category mostly involved students looking around the room. Table 4 breaks down the specific incident of behaviors by class. The majority of inattentive behaviors were observed as looking around the room which is

labeled as other on Table 4. Another frequently observed behavior was talking as indicated by Class A and C. Fidgeting was a common problem in Class A.

Table 4

Frequency of Inattentive Behavior

Inattentive Behaviors	Class A	Class B	Class C
Talking	22	13	46
Leaves seat	6	3	10
Fidgeting	41	15	13
Inappropriate response	6	4	1
Other	63	22	19

In summary, the data collected to document a student's enthusiasm for math indicates there is a repetition in the curriculum for some, or the curriculum is too fast paced for others. The reflective journals indicated that most of the students in the research study do not like whole group instruction. Students also indicated a lack of enthusiasm for math in the attitude survey by their responses to questions regarding free time spent on math, questions about math, and reading and writing about math. Most of the students in Class B and C replied that they had been taught concepts they already knew or moved on to new concepts before they were ready. The data also implies that students prefer certain teaching strategies which should be implemented to lessen these problems. The following section reviews probable causes for the lack of enthusiasm in math.

Probable Causes

The site and literature suggests several underlying causes for lack of enthusiasm during math in the school setting. The lack of enthusiasm may be demonstrated by students due to their frustration and boredom which can cause inattentiveness in a mixed-ability classroom. Gearing instruction to the middle ability group, repetition in curriculum, and the mismatch between teacher's strategies and students' learning styles may cause these problems. Each of these probable causes will be discussed.

Gearing Instruction to Middle Ability Group

According to Sisk (1988), the rationale for gearing instruction appropriately includes the following:

> Education's problem of bored and disinterested students is not a new one. In 1972, the U.S. Office of Education concluded that gifted and talented children were disadvantaged and handicapped in the usual school situation and that boredom results from discrepancies between the child's knowledge and the school's offerings leading to underachievement and behavior affecting self and others. (p. 5)

This seems to hold true based on the fact that instruction tends to be geared toward the middle ability group. This type of instruction can leave the gifted student bored while causing frustration for the lower achieving students.

According to Richardson and Suinn (as cited by Williams, 1988), students develop math anxiety which interferes with their ability to handle academic situations and everyday life that involve the manipulation of numbers. Tension and anxiety prevent lower level students from performing well in math which leads them to failure in mathematics (Williams, 1988). Often times, lower level students have not had enough time to understand concepts and skills before the

teacher moves on to the next lesson. A student who was learning disabled, expressed frustration because he needed more time to understand what was being taught (Tomlinson, 1995a).

On the other hand, higher level students are frustrated because they have already mastered the skills and concepts in the material before the teacher even introduces it. Classroom teachers feel guilty because they spend so much time reviewing material that above average students already know (Reis et al., 1993). "In front of the group the teacher lectures, explains, and demonstrates on a topic, asks and answers questions in front of the entire class, provides practice and drill exercises to the entire class, works on the same problems, and employs the same materials" (Ornstein, 1995, p. 105). Higher level and gifted students generally complete their work earlier than average and lower students. Instead of them being given challenging or enrichment material, often times they are just given more of the same work to do. Sometimes gifted students are put into a group by themselves and left to figure out the work on their own. During this time, the teacher focuses more on the needs of the average and below average students. When the teacher doesn't know what to do with gifted students, those gifted children become frustrated.

"Teachers generally gear their teaching to the 'mythical' average student on the assumption that this level of presentation will meet the needs of the greatest number of students" (Ornstein, 1995, p. 105). Lower and higher level students become frustrated because the pace of the scope and sequence in the math curriculum does not challenge the higher level students or accommodate the needs of the lower level students. Another probable cause is the repetition in the curriculum.

Repetition in Curriculum

Many good students get bored because they do the same thing year after year. According to Usiskin (1987) and Flanders (1987) (as cited in Reis et al., 1993), textbooks incorporate repetition and have decreased in difficulty. They also found that only 40-65% of the material found in second through fifth grade math textbooks covered new material (as cited in Reis et al., 1993). This type of tedious curriculum destroys the motivation of high ability students and stifles their ability to reach their full potential (Sisk, 1988). One way teachers address the needs of high ability students is to give them more of the same type of work. The students soon become aware that their only reward is yet another assignment of the same kind, thus producing underachievers.

Also, curriculum often does not relate to real life situations. The textbooks are geared towards pencil and paper activities that are not related to real life situations. For instance, in the teaching of money, children are given worksheets with pictures of money and are expected to transfer this concept. All math facts are expected to be memorized without understanding how to apply these in real life. This is another factor that causes boredom because students do not understand the relevance of what is being taught. If they cannot understand how information relates to their life, they do not understand why they need to learn the material.

"In virtually every elementary classroom in the country, all children will begin on the first page of their mathematics textbook during their first week in school, regardless of their ability level or whether they already know the material" (Reis et al., 1993, p. vii). Students have a hard time paying attention when the curriculum is approached in this manner. Student will also have a difficult time paying attention if there is a mismatch between the teachers strategies and the students' learning styles.

Mismatch Between Teacher's Strategies and Students' Learning Styles

Another factor that impedes the achievement of high ability students is the mismatch between teaching strategies and the learning styles of the students (Sisk, 1988). One strategy for teaching math in a mixed-ability class is using whole group instruction. This method involves the whole class learning the same information at the same time. Whole group instruction does not accommodate all students' learning styles or interests (Williams, 1988). The products required by this type of instruction often do not incorporate activities that utilize the multiple intelligences of all students. This can cause boredom and disinterest in the students whose needs are not being met.

There is a hierarchy of how students learn. The hierarchy indicates that if information is too hard or too easy learning will not take place. Therefore, new information must be presented where prior learning leaves off and new learning needs to begin. "Chall and Conrad (1991) stress the importance of the match between a learner's abilities and the difficulty of the instructional task, stating that the optimal match should be slightly above the learner's current level of functioning" (as cited in Reis et al., 1993, p.ix). If there is not this optimal match, then students may demonstrate a lack of attention, either knowing the information already or believing they will never know it. This problem may cause inattentive behavior such as talking, leaving work area, fidgeting, and inappropriate responses.

"According to Gardner, everyone possesses at least seven intelligences and each person's blend of competencies produces a unique cognitive profile" (Chapman, 1993, p. ix). The theory of multiple intelligences is important to the opportunity of learning. Teachers tend to teach to the verbal/linguistic and logical/mathematical intelligence (Chapman, 1993). Students who prefer other intelligences may feel frustrated because their unique intelligences and learning styles are not

being addressed. Students, including the gifted, are labeled as unmotivated and low achievers because teachers focus on two intelligences. Teachers are not addressing students who have special abilities in other intelligences (Chapman, 1993). There are other contributing factors that may cause inattentive behaviors in students.

Other Contributing Factors

Another cause for inattentive behavior is environmental distractions. Certain distractions are common and unavoidable in a school setting. These distractions include playground noise, students in transit between classrooms, noise from other classrooms, and anything happening outside the classroom windows.

Students who have been diagnosed with Attention Deficit Disorder (ADD) will exhibit inattentive behavior and have difficulty focusing on a task ("The Disability Named ADD," 1993). Children with ADD may exhibit characteristics such as fidgeting, difficulty remaining seated, interrupting conversations, and trouble following directions ("The Disability Named ADD," 1993). The child with ADD will generally try to get out of something repetitious or boring. They benefit best from a motivating and interesting curricula; however, some signs of inattentiveness may still be exhibited ("The Disability Named ADD," 1993). Teachers are becoming more aware of this type of problem in the classroom and realize they must incorporate strategies to try to lessen these behaviors.

In summary, teachers usually teach the math textbook to the whole class regardless of different ability levels within that classroom. Often times, higher and lower ability level children are either bored or frustrated which can cause inattentive behavior when math instruction is geared toward the middle ability group. In order to address these causes, a number of solution strategies were examined.

CHAPTER 3

THE SOLUTION STRATEGY

Literature Review

The trend in education is to incorporate all ability levels into one heterogeneous classroom. This presents a variety of problems for students as well as for teachers. Literature suggests a variety of methods to address the needs of all students in a mixed-ability classroom. The following is a literature review discussing techniques.

Differentiated Instruction

Differentiated instruction is based on meeting the needs of all students in a classroom. The key to differentiated instruction is to match a student's readiness with the types of instruction, activities and products that meet the needs of the student (Tomlinson, 1995c). A student's readiness can be measured by pretesting, teacher observation, and anecdotal records. Students' needs can be met by compacting, flexible grouping, and whole-class instruction.

The main advantage of differentiated instruction is that it meets the needs of students. Differentiated instruction provides a high degree of challenge and reduces instructional repetition for students (Miller, Mills, & Tangherlini, 1995). It addresses the learning styles and multiple intelligences of students (Tomlinson, 1995c).

Differentiating instruction is challenging because it is hard for teachers to acclimate their instruction and curriculum to meet the needs of students in a mixed-ability classroom (Tomlinson,

1995b). It is also time consuming to develop the material needed. Management of a differentiated classroom is difficult due to a variety of activities going on such as paperwork, grading, constantly reassessing, and off task behavior. Curriculum compacting is another solution, however, it is less difficult.

Curriculum Compacting

"Compacting allows students who demonstrate previous mastery of certain material to spend less time with the regular curriculum and more time with extension and enrichment opportunities" (Knopper, 1994, p. 8). According to Reis and Renzulli (1992), there are three phases to curriculum compacting. The first phase is to decide the objective of instruction. Next, teachers must identify the students who have mastered the objective. Finally, students who have mastered the objective are given acceleration and enrichment activities while the other students are working on teacher directed instruction.

Using compacting eliminates elitist labels because students may not always be in the same group. The nature of compacting is to create temporary groups of students based on skill mastery (Bailey, 1992). Therefore, groups may change each time a new objective is introduced. Compacting also eliminates boredom in gifted students when they are given work that is not challenging (Renzulli, Smith & Reis, 1983).

Teachers may be hesitant about using compacting because they feel they are allowing some students to omit material normally required in whole group instruction. When students are not accountable for the material taught during class, they may miss important concepts or vocabulary. This raises the concern of how to account for the mastery of the basic skills (Starko, 1986).

During compacting, the dynamics of the classroom constantly changes. At times, small groups may be involved in a variety of activities. Therefore, the management of these activities may be difficult. The teacher needs to provide challenging material for the group that has mastered the skills as well as the current and remedial material (Starko, 1986). Providing these materials is very time consuming for a teacher. In contrast, ability grouping is less time consuming for the teacher.

Ability Grouping

Ability grouping is assigning students to homogeneous groups based on achievement in a particular subject. The reason for using this type of grouping is to match the student's ability with the curriculum. Students usually remain in these groups year after year.

Proponents of ability grouping believe it is the most effective and efficient mode of teaching (Worthy & Hoffman, 1996). They believe it is the best way to individualize instruction, because high ability students are challenged while low ability students are working at their own pace (Fuligni, Eccles, & Barber, 1995).

A disadvantage to ability grouping is that students may be labeled or locked into one group. When low achieving students are placed in ability groups, they do not have the advantage of working with high ability students which affects their performance (Lumpkins, Parker, & Hall, 1991). According to Fuligni, Eccles, and Barber (1995):

> Those that support the Carnegie Council on Adolescent Development recommendation suggest ability grouping is an archaic educational practice. They argue the custom denies low-grouped students a challenging education, damages them psychologically, and channels them at an early age away from an equal opportunity in later education and employment. (p. 59)

Small group work such as cooperative and flexible grouping is another solution that can be used.

Small Group Work

There are various ways to group students within a classroom. Two forms of grouping are cooperative and flexible groups. Cooperative groups consist of two to five students working together in a heterogeneous group to accomplish a particular learning goal. Flexible groups are homogeneous groups set up temporarily to achieve a specific objective.

Cooperative learning is a key instructional strategy because of the many academic and social benefits. According to Slavin, cooperative learning increases self-esteem, achievement, and promotes positive race relations (as cited in Pigford, 1990). An additional benefit is that students become active participants in their own learning (Farivar, 1994).

Winebrenner and Devlin (1991) suggest that a drawback to cooperative grouping is that gifted students may become bosses or tutors when they are always placed in heterogeneous groups.

Other students in that group may rely on the gifted to complete the task; therefore, they are not active participants. Another consideration in using cooperative groups is teachers must remember to teach social skills such as being able to agree and disagree, encourage others to talk, and compromise (Farivar, 1994). Teaching social skills can be time consuming.

Flexible grouping enables students to work at their comfort level while being adequately challenged (Barbour, 1990). These groups are flexible according to the teacher or lesson objective; consequently, students are not labeled. All students are given many opportunities to exhibit their strengths in different areas. In contrast to cooperative groups, flexible groups are based on temporary ability skills. Compared to seatwork, working in a group offers a more

active, engaging learning experience. Students are involved in more task-oriented behaviors (Cohen & Benton, 1988).

Some of the disadvantages of small groups are that students have less direct contact with the teacher. Students may get off task because the teacher is working with another group. Small groups might have difficulty working together if the teacher hasn't spent enough time teaching social skills to the class. High ability groups get more teacher time than low ability groups (Pigford, 1990). Whole-group instruction is another method to be considered.

Whole-Group Instruction

Whole group instruction is teaching all students the same thing at the same time without regard to ability level. It is the most traditional method used to disseminate information.

According to Pardo and Raphael (1991), there are many reasons to use whole group instruction such as introducing a new concept, building common experiences, learning difficult text, reviewing material, sharing related background knowledge, and enrichment activities. Whole group instruction also gives students a feeling of community within the classroom (Tomlinson, 1995c).

A major problem with whole group instruction is that the content is not matched with the abilities of the students (Reis & Purcell, 1993). Teachers feel frustrated and guilty because they understand that some assignments are too easy for the above average students. Students are required to work on skills they have already mastered (Renzulli et al., 1983).

In summary, optimal learning occurs by differentiating math instruction. In order to meet the needs of all the students, a combination of whole group instruction and small groupwork are needed. Pretests should be administered before beginning a new chapter or concept in math to determine what skills students already know. Pretests are also used to determine base and

cooperative groups. These solutions will be incorporated into an Action Plan to address the problem of inattentive behavior and increase their enthusiasm for math.

Project Objectives and Processes

As a result of compacting and small group work , during the period of September, 1997 to December, 1997, the mixed-ability second/third grade self-contained cross categorical, regular education third, and regular education fifth grade math classes will decrease frustration and inattentiveness and increase motivation, as measured by the inattentive checklist, student surveys and reflective journals.

In order to accomplish the objective, the following processes are necessary:

1. Create enrichment activities
2. Create flexible and cooperative group activities
3. Develop math surveys, reflective journals, and inattentive behavior checklist
4. Instruct students on working in groups
5. Create flexible groups based on pretests

Project Action Plan

The following action plan was designed to decrease frustration, inattentiveness, and boredom as well as increase motivation during math. This plan will be implemented with the targeted mixed-ability second/third grade self-contained cross categorical, regular education third, and regular education fifth grade math classes.

This plan is to be implemented from September, 1997 to December, 1997. This plan will be conducted during math period four days a week. This schedule gives the researchers flexibility due to in-services, holidays, and assemblies.

Before the intervention takes place, math instruction will be taught as a whole group. Whole group instruction is one method used by these researchers in the past. During this time period the students will be observed for inattentive behaviors, using the inattentive behavior

checklist. Also during this time, each student will be asked to complete two surveys which will depict attitudes toward math.

The first strategy that will be utilized is whole group instruction. Each math period will begin with approximately 20 minutes of instruction directed toward the whole class. The purpose of this strategy is to introduce or reacquaint the students with math concepts and vocabulary. Whole group instruction helps build common experiences and share related background knowledge (Pardo & Raphael, 1991). The following skills that will be covered during whole group instructions are as follows: math facts, place value, addition and subtraction of two, three, and four digit numbers, money, time, graphing, decimals, multiplication and division. These skills will be covered based on the grade level of the teacher.

Compacting will be the second strategy utilized. The first step in compacting is to administer a pretest to determine whether or not a student has mastered the material. The criteria for mastery is 85% accuracy on the pretest. The students will be placed into flexible groups according to their pretest scores. One of these groups will consist of those students who have mastered the pretest, and they will be given enrichment activities. These may include extension activities, problem solving, math games, and puzzles. All activities will be math related, but may or may not be related to the current math unit. The students who have not mastered the material will be placed in flexible groups according to their pretest. The size of these flexible groups may vary according to the needs of the students. Flexible grouping gives the teacher the opportunity to work with the students based on their needs. The concept of compacting is based on meeting all the needs of every student, therefore, the pacing of instruction may vary.

The last strategy used will be cooperative groups. The purpose of this strategy is to have the students work together in heterogeneous groups known as their base groups. These base

groups will be formed according to their pretest and teacher observation. These base groups will be involved in activities such as: cooperative learning, problem solving, games, math centers, and math and literature.

Each week will incorporate all three of these strategies. All four days will begin with approximately 20 minutes of whole group instruction. Following whole group instruction, two days the students will be involved with flexible groups and the other two days with cooperative group activities. Students will write in their reflective journals two times a week, once after a flexible group day and once after a cooperative group day. They will reflect on how they felt about that particular math period. This reflective journal will be used as a data collection tool to document if frustration or motivation exists or changes. To document inattentive behaviors, a checklist will be used once every other week. The two student surveys that were given in September will be given again at the end of the intervention.

Methods of Assessment

In order to assess the effects of the intervention, data will be gathered from reflective journals, surveys, and inattentive behavior checklists. This information will provide evidence of how the intervention impacted students' attitude toward math.

CHAPTER 4

PROJECT RESULTS

Historical Description of the Intervention

The objective of this project was to increase students' enthusiasm for math while decreasing their frustration and inattentiveness. The implementation of whole group, compacting, enrichment activities, small group activities, and flexible groups were selected to effect the desired changes.

Whole group instruction was implemented for 20 minutes at the beginning of each math period. The purpose of this strategy was to introduce or reacquaint the students with math concepts and vocabulary.

Teachers administered pretests to students before moving on to a new concept or chapter. The criteria for mastery was 85% accuracy on the pretest. Students were placed in flexible groups according to their pretest scores and teacher observation. Students who mastered the pretest were challenged with enrichment activities. Low ability students were able to work at their own pace. The teacher had the opportunity to work with students based on their learning needs. Compacting allowed students who have already mastered concepts to spend less time on previously learned material and more time on enrichment activities. The purpose of compacting was to meet the needs of every student.

Small group work enabled students to work in heterogeneous groups. These groups were involved in activities such as cooperative learning, problem solving, games, math centers, and math and literature. Small group work was a key instructional strategy because of the many academic and social benefits.

Each week incorporated all three of these strategies. The intervention consisted of a four day rotation. The four day rotation was designed to allow the fifth day to accommodate for changes in the school schedule such as holidays and days off. Although the fifth day was built into the action plan, completing the four day rotation was still difficult due to unexpected variances in the schedule. The variances included assemblies, math review, posttesting, and having a substitute teacher due to sickness or teacher meetings. The math period began with approximately 20 minutes of whole group instruction. Following whole group instruction, two days the students were involved with flexible groups and the other two days with cooperative group activities.

At the time of this action plan, a new math series was being introduced, which led to some of the following concerns. The scope and sequence of the new math series was more advanced than the previous series used; therefore, the students did not do as well on the pretests. This decreased the opportunities for students to qualify for enrichment activities. Several tools were used to assess the intervention.

Presentation and Analysis of Results

In order to assess the effects of the intervention on the targeted students, the researchers used information from reflective journals, behavior checklists, and student surveys. This data is presented in Tables 5 through 8.

Reflective Journal

In order to assess the effects of the intervention on the targeted students, a reflective journal was completed by each student to reflect how they felt about that particular math lesson. Each week the students reflected on either a whole group, flexible group, or cooperative group lesson. A total of four reflective journals were completed in each category. They were asked whether they liked the activity and then to indicate how they felt about math class. They were also asked to explain why they indicated these choices. This data was compiled and is presented in Table 5.

The intervention appears to have had mixed results. Class A and C responded positively to the whole group format. More than 60% of both classes felt happy about whole group instruction. Class B responded more negatively to the whole group lesson with approximately 41% feeling happy.

Flexible and cooperative group results were more positive in all classes. Over 70% of all students felt happy about flexible group activities. Class B and C responded more favorably toward cooperative groups than class A. Approximately 55% of Class A felt happy about cooperative groups. However, over 65% of Class B and C felt happy about this grouping.

The written responses in the reflective journals and teacher observation indicated that some students were reflecting on issues not relating to the activity. Some students were reflecting on who they were working with rather than the activity. Other students based their reflections on the concept being taught. For example, some students responded negatively to a lesson because they did not like subtraction. Some students also were frustrated learning new procedures for the activities. The behavior checklists were also used to show the number of inattentive behaviors during different instruction types.

Table 5

Reflective Journal

Instruction Type	Class A ☺	Class A 😐	Class A ☹	Class B ☺	Class B 😐	Class B ☹	Class C ☺	Class C 😐	Class C ☹
Whole	70.9%	19.3%	9.6%	41.2%	37.5%	21.2%	62.3%	27.0%	10.5%
Flexible	73.3%	3.3%	23.3%	72.7%	20.7%	6.4%	75.0%	21.2%	3.7%
Cooperative	54.8%	12.9%	32.2%	69.0%	17.8%	13.1%	67.0%	22.7%	10.1%

Behavior Checklist

A tally of inattentive behaviors was maintained every other week throughout the intervention. Each time data was gathered from a whole, flexible, or cooperative group lesson. Therefore, there were two checklists for each lesson design. The data from the two checklists for each lesson design were combined and are shown in Table 6.

Table 6

Frequency of Inattentive Behavior

Inattentive Behaviors	Class A Whole	Class A Flexible	Class A Coop.	Class B Whole	Class B Flexible	Class B Coop.	Class C W hole	Class C Flexible	Class C Coop
Talking	0	32	3	0	1	0	19	4	1
Leaves seat	4	2	0	1	0	2	3	4	5
Fidgeting	33	23	1	14	7	1	0	0	0
Inappropriate response	19	10	0	2	3	0	0	1	0
Other	43	47	5	30	11	16	28	15	8
Total	99	114	9	56	22	19	50	24	14

Whole and flexible group reflects more inattentive behaviors than cooperative groups. All groups showed the lowest incidences of inattentive behaviors during cooperative group lessons. During this time, all classes recorded under 20 inattentive behaviors. Class B and C showed the most inattentive behaviors during whole group instruction. However, Class A

showed the most inattentive behaviors during flexible group lessons. In addition to the behavior checklists, students were resurveyed about the scope and sequence of the curriculum.

Scope and Sequence Survey

The Scope and Sequence survey was re-administered at the end of the intervention. This survey was given to show the pacing of instruction. Due to the fact that whole group instruction was required for all students, it was expected that concepts would be repeated for some students. This is indicated in Table 7.

One of the goals of this intervention was to decrease frustration by not moving on to new concepts before the students were ready. Table 7 shows that over 60% of students in all classes were ready to move on to new concepts. Compared with the same survey that was given at the beginning of the intervention, 40% more students from Class B felt that the pacing was correct for them. Class C also showed an increase of 20%. This information suggests that the intervention was successful. Similar results were apparent in the attitude survey.

Table 7

Students' Post Survey Regarding Scope and Sequence of Math Instruction

	Class A Yes	Class A No	Class B Yes	Class B No	Class C Yes	Class C No
Taught Concepts Already Known	57%	43%	100%	0%	86%	14%
New Concepts Taught before Ready	28%	72%	23%	77%	36%	64%

Attitude Survey

An attitude survey was re-administered upon the completion of the intervention period to note the changes in students' attitudes toward math. A breakdown of the results are shown in Table 8. Class B and C indicated that they felt more positive towards math in school as compared

to the survey taken at the beginning of the intervention. Twenty-six percent more of Class B indicated that they felt happy with math in school. Class C showed an increase of 18%. However, 25% less of the students in Class A indicated that they felt happy with math in school. This may be due to the introduction of new concepts which may be difficult for them at first.

All three classes seem to enjoy spending free time on math as compared to the beginning of the intervention. Class A went from 33.3% to 50% of the students feeling happy about spending free time on math. This indicates a 17% increase. Class B showed a 50% increase, and Class C showed a 23% increase. This information shows that the students are more enthusiastic about math because they want to spend their free time working on math activities.

Table 8

Students' Attitudes Toward Math After the Intervention

	Class A			Class B			Class C		
	☺	😐	☹	☺	😐	☹	☺	😐	☹
Math in School	25.0%	50.0%	25.0%	77.2%	22.7%	0%	63.6%	36.3%	0%
Math at Home	25.0%	12.5%	62.5%	50.0%	27.2%	22.7%	22.7%	50.0%	27.2%
Math with a Friend	62.5%	25.0%	12.5%	90.9%	4.5%	4.5%	77.2%	22.7%	0%
Free Time on Math	50.0%	0%	50.0%	63.6%	31.8%	4.5%	59.0%	36.3%	4.5%
New Skill or Concept	50.0%	0%	50.0%	63.6%	36.3%	0%	59.0%	35.3%	4.5%
Using Manipulatives	25.0%	25.0%	50.0%	45.4%	36.3%	18.1%	22.7%	50.0%	27.2%
Questions about Math	25.0%	0%	75.0%	40.9%	50.0%	9.0%	50.0%	50.0%	0%
Worksheets	37.5%	0%	62.5%	45.4%	36.3%	18.1%	36.3%	27.2%	36.3%
Small Group Work	62.5%	0%	37.5%	63.6%	27.2%	9.0%	68.1%	31.8%	0%
Reading about Math	37.5%	25.0%	37.5%	45.4%	22.7%	31.8%	22.7%	50.0%	27.2%
Writing about Math	37.5%	0%	62.5%	66.6%	50.0%	13.6%	22.7%	36.3%	40.9%
Math Tests	12.5%	0%	87.5%	45.4%	27.2%	27.2%	31.8%	50.0%	18.1%

Conclusions and Recommendations

Based on the presentation and analysis of the data on students' attitude toward math, the

students have shown an increase in their enthusiasm for math. The data indicated that the students enjoyed flexible and cooperative activities over whole group lessons. Also, behavior checklists showed a decrease in inattentive behaviors when students were working in small groups versus whole group instruction.

The researchers would recommend students working in flexible and cooperative groups because students enjoyed working in small groups. Compacting allowed higher level students to work on enrichment and extension activities, while lower level students were given remedial help. Cooperative groups provided mixed-ability students time to work together. Although students enjoyed working in small groups, teachers should spend time teaching cooperative group skills. Some students had difficulty working with others. This could have influenced the way they responded in their reflective journals and surveys. Also, not all math concepts lend themselves to group work. For example, it was hard to develop activities for concepts such as: subtraction with double digits, place value, and long division.

Students also enjoyed playing math games. However, Class A and C both experienced problems with math games. The math games were new and the instructions were difficult to understand. The students needed to practice the game in order to enjoy it; therefore, the reflective journals may express a frustration with instructions rather than the math concept.

The researchers feel that the strategies used were effective in the special education classroom. Although, some modifications were necessary. Modifications were made in the strategy of compacting. Changes were made because of the wide range of math ability levels within the classroom. Usually, the groups in a special education classroom are distinct because ability levels can span several grade equivalent levels and instruction is individualized. Due to this, using compacting as stated for this intervention, the same students would always be working

on enrichment activities while the lower ability students would always be getting teacher instruction. This eliminates the concept of flexible groups. Therefore, during flexible group days each student was given enrichment activities at their level as well as teacher instruction. Enrichment activities were usually done in small groups.

The students in the special education classroom enjoyed working in cooperative groups. Due to the distinct groups in a special education classroom, there is an awareness of each other's ability levels. The use of cooperative groups made students less aware of this and minimized labeling. The use of cooperative groups dramatically decreased the inattentive behaviors.

Whole group instruction was also a valuable tool in the special education classroom. Before the intervention, Class A rarely used whole group instruction. Typically, the students would work on individualized math skills. The incorporation of whole group instruction introduced math concepts and vocabulary that are important regardless of student's ability level. These concepts included problem solving, identifying key math words, and concepts of numbers. These skills were often worked on individually.

The researchers' district is incorporating differentiated instruction which bases instruction on meeting the needs of individual students. The researchers feel that the incorporation of compacting helps accomplish this goal. Compacting allows high ability students to be challenged with enrichment activities and allows remedial help for low ability students. Students were more enthusiastic about math because they were able to work on skills they were ready for. Students that worked on enrichment activities were happy because they didn't have to repeat skills previously mastered. Lower ability students were given more individualized attention which decreased their frustration. The researchers feel that these strategies would help other teachers trying to incorporate differentiated instruction.

The researchers feel that the strategies utilized were effective. However, we feel that more students would be enthusiastic about math if they were in the enrichment group. Many students did not qualify for the enrichment group due to the adoption of a new math series. This math series is more difficult than the previous math series. Therefore, many of the skills the children were pretested on were too challenging. The researchers conclude that these strategies will be even more effective after using the math series for three or four years.

As indicated in Chapter 1, teachers generally direct instruction towards the average learner. This can present problems in a mixed-ability classroom. Lower, middle, and higher ability students may demonstrate inattentiveness, frustration, and a lack of motivation when teachers teach to the average learner. The researchers feel the intervention was successful in meeting the needs of all students.

The lesson design for math instruction included approximately 20 minutes of whole group instruction followed by either flexible group instruction or cooperative group work. Whole group instruction provided a time for the introduction of new math concepts and vocabulary. It also provided an opportunity for the class to gather as a whole. The use of compacting helped eliminate frustration and boredom in students because instruction was geared to meet the wide variety of student ability levels. Higher ability students were involved in enrichment activities while middle and lower ability students were involved in activities to reinforce skills and concepts being taught. Cooperative group work significantly increased enthusiasm for math while decreasing inattentive behaviors. This heterogeneous grouping helped eliminate labeling.

In conclusion, this model is recommended because it increases enthusiasm for math while decreasing inattentive behaviors during math. It is important for students to work together in groups. Also, the constant changing of the group members minimized the labeling of high and

low ability students. Whole group instruction is important because teachers need to make sure all students are exposed to vocabulary, new strategies, and concepts. The use of these instruction models will encourage students to continue enjoying math.

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APPENDIX A

REFLECTIVE JOURNAL

REFLECTIVE JOURNAL NAME:_____
DATE:_____

DID YOU LIKE THE ACTIVITY? YES____ NO____

CIRCLE THE WAY YOU FELT ABOUT MATH CLASS TODAY.

HAPPY OKAY SAD

PLEASE EXPLAIN WHY YOU FELT THIS WAY.

APPENDIX B

ATTITUDE SURVEY

NAME:_____DATE:_____

MATH SURVEY

Directions: Circle the face that best describes how you feel.
☺ = HAPPY 😐= OK ☹= SAD

1. How do you feel about math in school?

☺ 😐 ☹

---

2. How do you feel about doing math at home?

☺ 😐 ☹

---

3. How do you feel about working on math with a friend?

☺ 😐 ☹

---

4. How do you feel about spending free time on math?

☺ 😐 ☹

---

5. How do you feel about learning a new skill or concept in math?

☺ 😐 ☹

---

6. How do you feel about using manipulatives to figure out math problems?

☺ 😐 ☹

---

7. How do you feel when the teacher asks you questions about math?

8. How do you feel about doing math workbook pages and worksheets?

9. How do you feel about working on math activities in small groups?

10. How do you feel about reading books about math?

11. How do you feel about writing about math?

12. How do you feel about taking a math test?

APPENDIX C

SCOPE AND SEQUENCE SURVEY

NAME:_____

DATE:_____

Directions: Answer the following questions.

1. During math class, have you ever been taught concepts that you already know?

   YES_____ NO_____

2. During math class, have your teachers ever moved on to something new before you were ready?

   YES_____ NO_____

3. What do you like about math?_____

4. What don't you like about math?_____

APPENDIX D

INATTENTIVE CHECKLIST

INATTENTIVE BEHAVIORS
DATE:_____
TIME/PERIOD:_____

	TALKING	LEAVES SEAT	FIDGETING	INAPPROPRIATE RESPONSE	OTHER
NAME					